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Perceptual Style and Air-to-Air Tracking Performance

Paul Atchley

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Perceptual Style and Air-to-Air Tracking Performance

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PERCEPTUAL STYLE AND AIR-TO-AIR TRACKING PERFORMANCE

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SUMMARY

The relationship between perceptual style and tracking of a target was examined. Four pilots were given the Embedded Figures Test to assess their degree of field-dependence or independence. They then flew in a helicopter simulator and attempted to track an airborne target. A significant correlation was found between perceptual style and tracking performance. Field-independent subjects were able to track the target for longer periods than field-dependent subjects.

INTRODUCTION

An Air-To-Air-Tracking Study (ATATS) was conducted at the Crew Station Research and Development Facility (CSRDF) at the NASA Ames Research Center, Moffett Field, California. The primary purpose of ATATS was to investigate control differences between head-mounted and hand-operated targeting mechanisms. The effect of the control laws governing these mechanisms was also examined (Hennessy, R. Air-to-Air Tracking Study. Contractor's report: Contract number NAS2-13008. In preparation.).

In addition to the primary study, a sub-study was conducted to examine the relationship between perceptual style and tracking performance. The perceptual style examined in this study was the level of field-dependence or field-independence (FD/FI) of the subjects in the study. Field-dependence theory has primarily been the work of Witkin (1950,1964) and his colleagues. Field-dependence theory states that people have a particular style (ranging from FD to FI) that mediates their perceptual and cognitive processes. Field-dependent individuals tend to be influenced by the general content of a given scene whereas field-independent subjects notice and are influenced by individual attributes.

Field-dependence/independence also has been shown to be related to such factors as body awareness, interpersonal dynamics, and learning style; however in this study, only perceptual factors were considered. Different assessment tools are used for measuring FI/FD, depending on the emphasis of the study. In the study described here, the Embedded Figures Test (EFT) was considered appropriate because this test relies completely on the perceptual abilities of the subject (Witkin, Oltman, Rasking, and Karp, 1971). The commonly used assessment device, the Rod-and-Frame Test (RFT),

was not used because it relies heavily on the spatial and body orientation abilities of the subject, rather than on perceptual abilities.

The hypothesis of the study was that FI subjects would be more adept in tracking a moving target on a similarly colored background than are FD subjects. Field-dependent subjects should be less able to discriminate between the target and its background and this deficiency would be reflected by slower acquisition times and less time on target.

METHOD

Subjects

Four U.S. Army pilots from Fort Ord, California, participated in the study. Subjects were male, with a mean age of 25 and a mean of 517 flight hours of experience in rotary wing aircraft. All subjects were treated in accordance with American Psychological Association Ethical Guidelines.

Materials

The simulator used for the study was a fixed-base, wide field of view (WFOV) advanced helicopter simulator (Henderson, 1989). However, for this study, the WFOV capabilities were not used. Visuals were presented on a small video display or in a limited portion of the helmet mounted optical display. Data from the testing was recorded using a DEC 8650 microcomputer.

To assess FD/FI, the long version (24 test cards) of the EFT was used.

Method

The description of the method used reflects only those portions of the larger study relevant to the current investigation.

Prior to flying the simulator, each pilot was administered the A Series of the EFT consisting of 12 of the 24 possible cards. The subject was asked to view a colored set of geometric figures for 15 sec, then look at a target geometric figure for 10 sec. After removal of the target figure the subject again looked at the colored set of figures. The subject's task was to find the target figure embedded in the colored set as quickly as possible. The test is analogous to looking for an object hidden within the context of a larger picture. Each subject was given a maximum of 3 min per card. Short search times on the EFT are associated with field-independence and long search times indicate field-dependence.

The pilots then completed a tracking task in the simulator. Each task took approximately 35 min. The pilots completed two tasks per day for 10 days over a 2-week period. The tracking task consisted of maintaining a sight reticle (crosshairs) on a moving target for the longest duration possible. The

image generated for the task simulated an image seen through a forward looking infrared (FLIR) radar. The image (target and background) was a monochrome green to green-grey color. Performance data was collected automatically by computer during the trials.

After the pilots completed their last tracking trial, they were given Series B of the EFT consisting of the second 12 of 24 cards. A final perceptual style score was then computed for each pilot. Scores were standardized (z) scores based upon the average per trial search time of each pilot.

RESULTS

A test for significant differences between proportions (Bruning and Kintz, 1968) was conducted. Pilots differed significantly in their ability to track the target, $z = 3.55$, $p < .05$. To ascertain whether FD/FI was related to tracking performance, a Pearson's r correlation using scores on the EFT and subject's percentage time on target was conducted. The correlation between the two measures was -0.93 , $p < 0.05$. Field-independent subjects (shorter times on the EFT) had longer tracking times than field-dependent subjects. No significant difference was found between scores on the first and second administrations of the EFT, or between the head and manual tracking conditions.

CONCLUSION

The strength of the relationship between perceptual style and tracking ability is promising. Intuitively, it follows that subjects who have difficulty finding a geometric figure in a background with similar figures will have equal difficulty tracking a vehicle that is similar in color, and perhaps texture, to its background. Such a finding would mean that gunners or other persons trying to track an effectively camouflaged vehicle may have difficulty if they are field-dependent. However, while the correlation between EFT scores and time on target was significantly related in the predicted direction, the small sample size ($n = 4$) precludes sure fit of a linear model. As is the case with many experiments, further research needs to be conducted to further substantiate the current findings.



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REFERENCES

- Bruning, J. L. and Kintz, B. L.: Computational Handbook of Statistics. Glenview, Ill.: Scott, Foresman and Company, pp. 199-121, 1968.
- Henderson, B. W.: Simulators Play Key Role in LHX Contractor Selection. Aviation Week and Space Technology, vol. 131, no. 22, pp. 34-37, 1989.
- Witkin, H. A.: Individual Differences in the Ease of Perception of Embedded Figures. J. Personality, vol. 19, pp. 1-15, 1950.
- Witkin, H. A.: Origins of Cognitive Style. In C. Sheerer (Ed.), Cognition: Theory, Research, Promise. New York: Harper & Row, 1964.
- Witkin, H. A., Oltman, P. K., Raskin, E., and Karp, S. A.: A Manual for the Embedded Figures Tests. Palo Alto, CA: Consulting Psychologists Press, 1971.

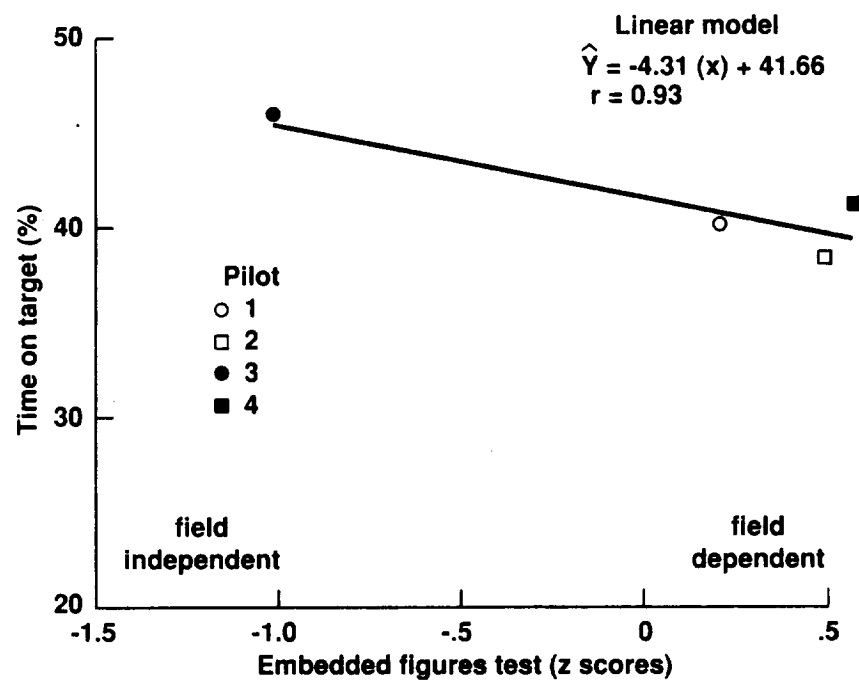


Figure 1. A linear model of tracking performance as a function of perceptual style.



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